Space Weather Technical Forecast

Issued on Thursday, 03 August 2023 at 13:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares giving R1-R2 Blackouts are likely. CME arrivals anticipated Days 2-4 (04-06 Aug) with a chance of G1/Minor Storm activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate solar activity with occasional M-class flares, peaking at M2.0 at 03/1147 UTC from AR3392. There are now nine numbered and one un-numbered sunspot regions on the visible disc. The largest region remains AR3380 (Eac/Beta-Gamma-Delta) in the southwest, any changes to classification becoming increasingly difficult to discern as it approaches the limb though some reduction in area looks likely. The elongated area AR3392 continues to see some slight development, now Ehi/Beta, but remains magnetically fairly simple. Newly numbered region AR3394 is emerging in the southeast, this remains tentatively classified as Hsx/Alpha, though significant looping in the region suggest further complexity may be yet to emerge. The other regions appear stable and have shown little change. A small Bxo/Beta region also emerged near central disk as is currently un-numbered. A full-halo CME was observed leaving the Sun around 02/0900 UTC. This is expected to arrive at Earth either Late on day 3 (5th) UTC day or early on day 4 (6th). Also, two filament lift-offs from the northeast disc late 31 Jul (and observed on C2 imagery early 01 Aug) are considered to have Earth-directed components.

Solar Wind / Geomagnetic Activity: The solar wind at L1, as measured by ACE, was at mostly slow-ambient levels, between 330 and 390 km/s. Density was average or above average to start, with a period peak close to 20 ppcc around 02/1400 UTC, but fell below average from around 03/1000 UTC. The total interplanetary magnetic field strength (Bt) was at weak to moderate levels with a peak of 12nT at 02/0412 UTC, and signs of a increase once again from 03/1000 UTC. The north-south component was also weak to moderate with a more prolonged southward directed orientation after 02/0400 UTC. Phi angle was initially negative (away from the Sun), becoming increasingly positive (towards the Sun) around 02/1300 UTC and again from 03/1000 UTC. Geomagnetic activity was generally Quiet (Kp 1-2), but with Active intervals 02/1200-1800 UTC.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux varied from background to moderate levels. The associated 24-hour integrated fluence remained below the Active level (1e8 integrated pfu), with 6.16e6 integrated pfu recorded at 02/2359UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is expected to be Moderate, with a slight chance of becoming High. This mainly due at least in the short term to the potential for M-class flares, along with a slight chance of X-flares, from AR3380 on the southwest disc. Other regions contribute to the flare risk, including a recently emerged region in the southeast.

Solar Wind / Geomagnetic Activity: Two CMEs may give glancing blows on Day 2 (4th Aug),

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but possibly into Day 3 (5th Aug). A higher confidence CME expected to impact Earth into day 3 or early day 4 (6th Aug). Solar winds at slow-ambient levels to start, perhaps becoming slightly elevated 400-500km/s into the period due to transient HSS and potential CME influence. Low confidence in details. Geomagnetic activity is expected to be Quiet to Unsettled (Kp0-3) on day 1 (3rd Aug), becoming Unsettled to Active with a chance of G1/Minor Storm intervals from late Day 2 into Day 4.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is currently at background levels. There is a slight chance of enhancement from any notable flares that occur, most likely emanating from AR3380 in the near term. The high energy electron flux (greater than 10 MeV) is currently expected to remain at normal background to moderate levels through the period. The associated fluence is most likely to remain below the Active threshold (1e8 total pfu).

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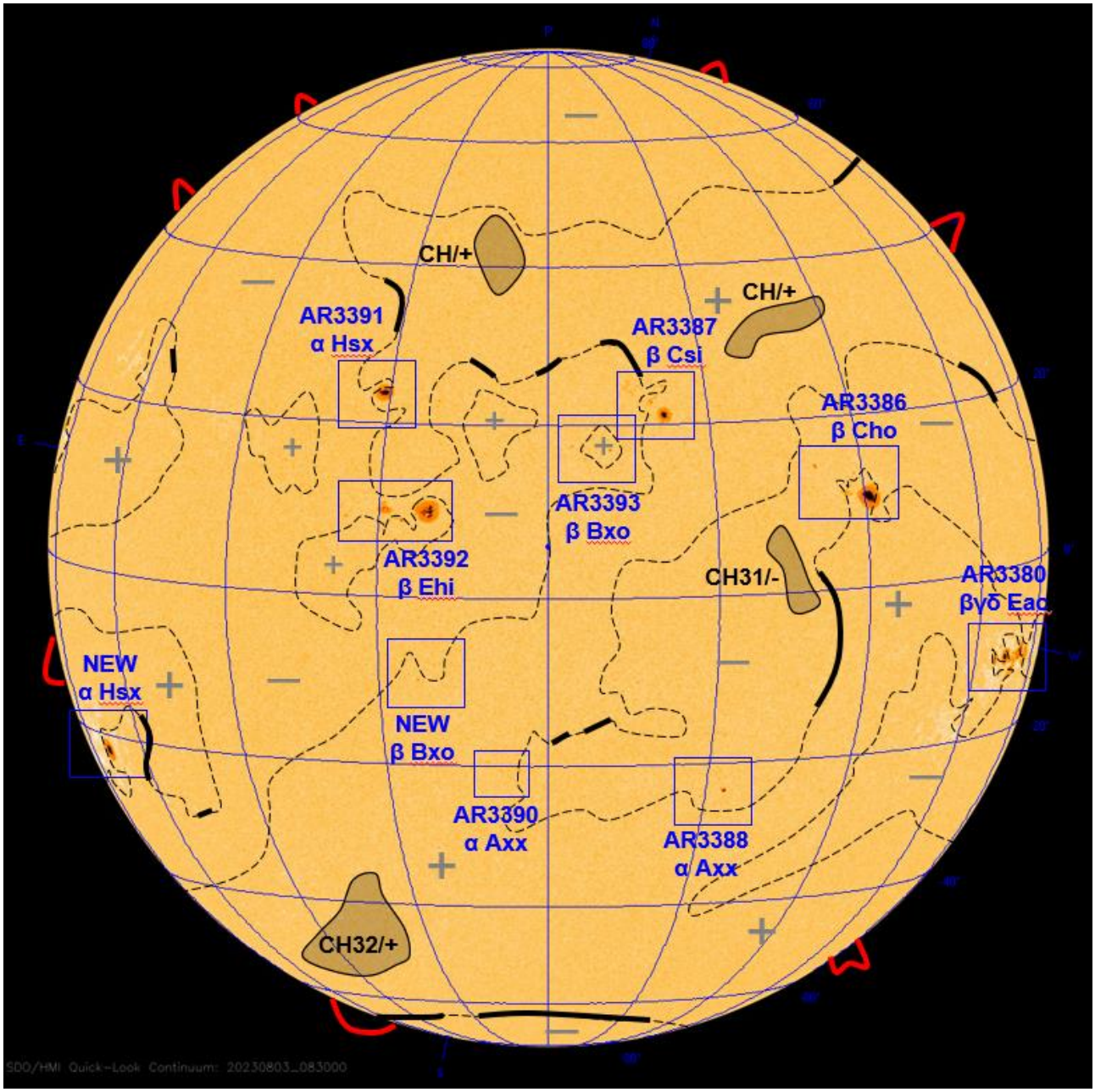
Figure 1. Solar Analysis Valid 03/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A disappearing solar filament occurred in the centre disc from 31/1800 UTC, alongside a C5 flare from AR3380 with a CME, considered to be associated, appearing towards the southwest. In addition, two filament lift offs from the northeast disc produced a CME towards the northeast. Both of these are considered to have an Earth directed component, with arrivals anticipated on Day 2 (04 Aug), but possibly early on Day 3 (5th Aug). Low confidence due to lack of Stereo-A imagery available for analysis. A full-halo CME left the Sun around 02/0900 UTC. This has been currently modelled to arrive into Day 3 or perhaps early day 4 (6th Aug).

Solar winds are currently at slow-ambient levels, but close to slightly elevated levels, with some enhancement from what looks to be connection to a faint high speed stream (HSS) from either CH31/- or perhaps an unnumbered CH/+ in the northwest disc. Both these features are low confidence however they are coincident with more well defined and likely stronger coronal holes on the previous rotation. Any enhancement from these features is expected to persist into Day 2 (4th Aug) before generally waning, but may give speeds of 400-450km/s. From Day 2 through to Day 4 there is the increasing chance of CME impacts most reliably from the 02/0900 UTC CME, and these could see winds reach towards 500-550km/s, particularly if they combine with HHS enhancement.

Geomagnetic activity is expected to be Quiet to Unsettled (Kp0-3) on day 1 (3rd Aug), becoming Unsettled to Active with a chance of G1/Minor Storm intervals from late Day 2 into Day 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	30	30	30
Strong	G3	No	1	5	5	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/0701	Partial	Filament eruption	NE	599km/s	04/0300 UTC	Glancing blow
01/0827	Partial	Filament eruption	SW	424km/s	04/1400 UTC	Glancing blow
02/1600	Full	Filament eruption	Centre disk	520km/s	05/2359 UTC	Direct hit possible

Figure 2: Latest MOSWOC ENLIL Ensemble output

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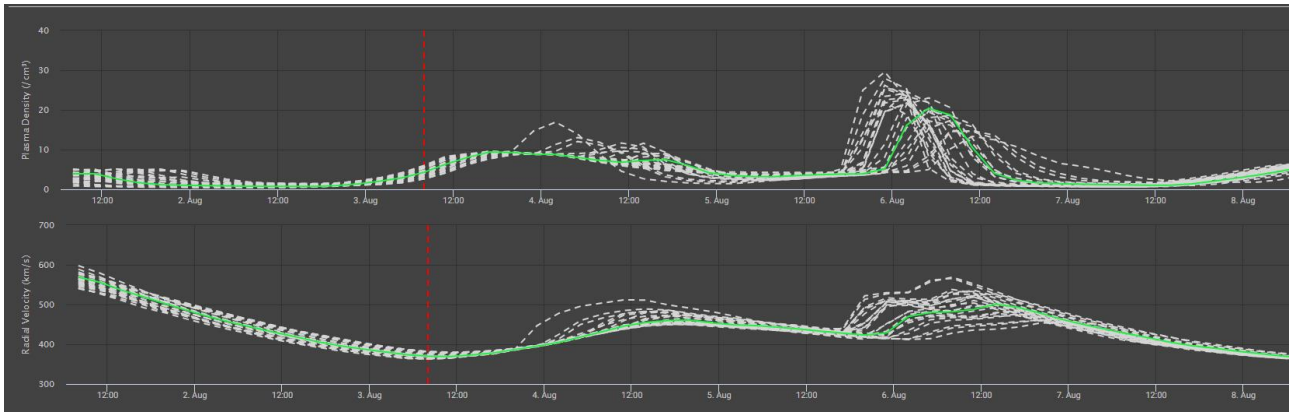

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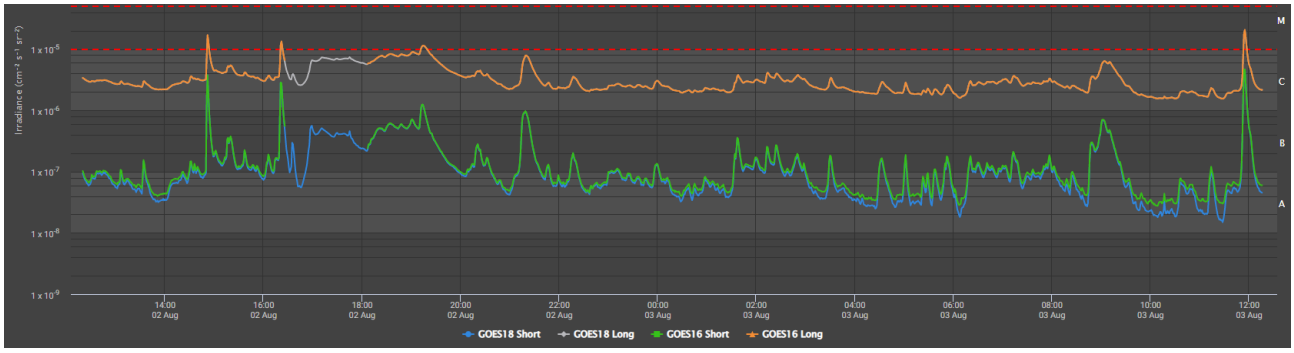
Radio Blackouts - X-Ray Flares:
Solar activity is Moderate. There are currently nine sunspot regions on the visible disc. The largest and most significant region on the disc remains AR3380 in the southwest. This region is fairly unstable, and has been the source of a number of M-class flares over recent days. Stronger flares remain possible, with further M-class flares likely from this region as it continues to round the limb and a slight chance of X-class flares, with influence from this region likely to only ease from day 3 (5 Aug). The elongated area AR3392 in the northeast continues to see some slight development, now Ehi/Beta, but remains magnetically fairly simple though the proportion of the flare risk from this spot has increased. Newly numbered region AR3394 is emerging in the southeast, this remains tentatively classified as Hsx/Alpha, though significant looping in the region suggest further complexity may be yet to emerge.

Moderate activity is likely to continue with a slight chance of reaching High. The main contribution to probabilities remains AR3380 in the southwest, with flare potential from this region only slowly declining, perhaps to be replaced by the other moderately large regions on or emerging onto the disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	65	60	60
Very Active	R3 to R5 X Class	No	10	10	5	5

Figure 3: 24hr X-Ray Flare trace



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Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux is at background levels. The main risk of enhancement currently is from the complex region AR3380 in the southwest disc, but this risk likely continued into the period as current larger regions near central disk increasingly rotate into the western hemisphere. Any significant flares will bring a chance of increases in proton flux, with a slight chance of exceeding S1/Minor Storm threshold.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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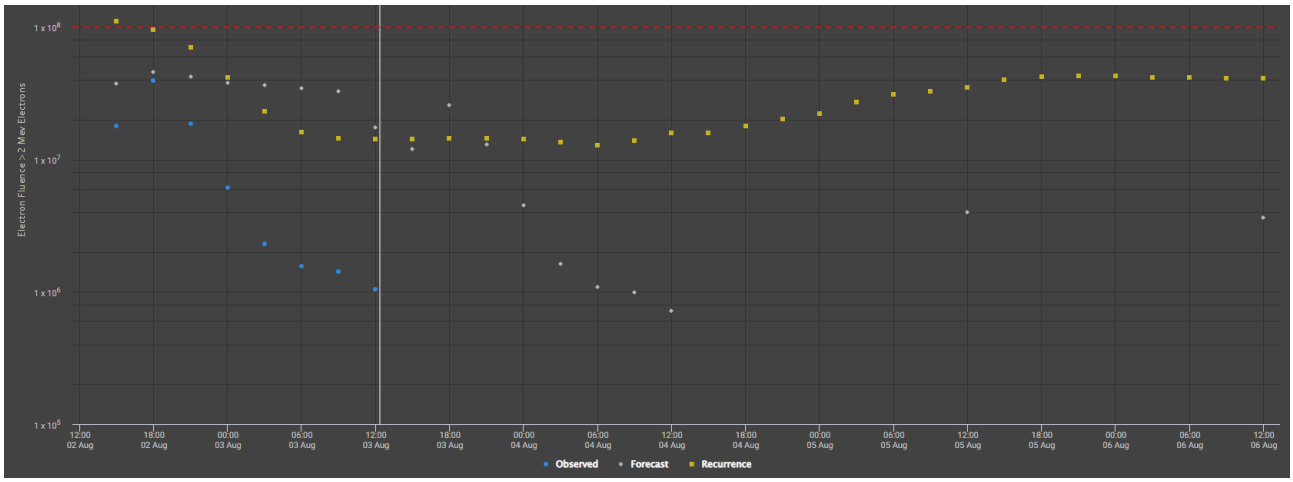
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 10 MeV) is currently expected to remain at normal background to moderate levels through the period, as CME potential and the lack of significant HSS's act to suppress flux values.

The associated 24 hour fluence is forecast to remain below Active (1e8 total pfu). The Met Office REFM output is currently giving a reasonable steer for initial conditions, but confidence in the model falls as the period advances.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	5	10	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model output



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